Summer rain, stubble management and nitrogen

Funded by the GRDC Water Use Efficiency Initiative and conducted in collaboration with SARDI and the University of Adelaide.

Key findings

- The presence of stubble did not increase stored soil moisture, regardless of the size and number of irrigation events.
- In 2010 additional soil moisture at sowing did not generally increase final grain yield.
- Additional soil moisture can increase crop demand and response to nitrogen.

Why do the trial?

In south-eastern Australia, cereals depend on two sources of water: water stored in the soil during summer fallow, and in-season rainfall. However, the actual value of capturing out-of season water in the Mid-north region of SA is uncertain. In contrast to the dominance of small events in winter rainfall, summer rainfall is characterised by large storm events. The potential for deep-storage of water in soils is greater in large events.

This trial aimed to measure the interaction between stubble management, frequency of rainfall events and fertiliser nitrogen on:

- the retention of soil water accumulated outside the growing season.
- the value of stored water to crop physiological traits and yield.

How was it done?

Plot size	8m x 6m	**Fertiliser**	DAP @ 60 kg/ha
Seeding date	3rd June 2010	**Variety**	Gladius wheat @ 90 kg/ha

Trial 1 – The influence of summer rainfall events and stubble on storing water

This trial was a randomised complete block design with 4 replicates and 8 treatments resulting from the combination of two stubble and four rainfall treatments.

Rainfall treatments:

- Control (no added water)
- 1 event (100mm) – applied 1st February using trickle irrigation
- 2 events (50mm applied twice) – 1st February and 1st March
- 3 events (33mm applied three times) – 1st Febraury, 1st March and 22nd March

Stubble treatments:

- Bare ground control
- Standing (2.4 t/ha)

Trial 2 – The interaction of stored water and nitrogen on grain yield

These trials were randomised complete block designs with 4 replicates and 4 treatments resulting from the combination of two rainfall and two nitrogen treatments. They were located alongside previously established water use efficiency sites. The sites were sown at different times: Hart (3rd June), Roseworthy (3rd June) and Spalding (6th May).

Rainfall treatments:

- Control (no added water)
- 1 event (100mm) – applied 12th February (Hart), 23rd February (Roseworthy) and 24th March (Spalding) using trickle irrigation

Nitrogen treatments:

- Low: 20 kg N/ha (Hart) or 0 kg N/ha (Roseworthy and Spalding)
- High: 70 kg N/ha (Hart), 80 kg N/ha (Roseworthy) or 100 kg N/ha (Spalding)

All trials were sown with 50mm chisel points and press wheels on 22.5cm (9") row spacings. The standing stubble treatments were inter-row sown in trial 1.

All plots were assessed for dry matter, grain yield, yield components and grain quality.

Crop physiological traits were measured throughout the season such as; light interception (ceptometer), NDVI (greenseeker), chlorophyll content (SPAD) and canopy temperature (infra red camera). Soil moisture was measured using a capacitance probe (Diviner 2000).

Results

The mild finish to the season and adequate water supply provided ideal growing conditions. As a result additional stored moisture in the subsoil did not influence final grain yield or quality.

Trial 1 – The influence of summer rainfall events and stubble on storing water

The removal of stubble did not influence the amount of water available at sowing and the size of the rainfall event was also insignificant. All the summer rainfall treatments significantly increased plant available water (PAW) to one metre of soil depth at sowing (Table 1). Most of this water was stored below 60cm.

Table 1: Plant available water (mm) at sowing for each summer rainfall treatment and averaged across stubble treatments.

Number of rainfall events	PAW (mm)	
Nil	64.4	a
1	101.3	b
2	92.0	b
3	100.4	b
P Value	<0.0001	

Although there was between 30-40mm of additional moisture in the soil at sowing, this did not contribute to the final grain yield. There was no significant difference between grain yield, grain weight or harvest index measured between the moisture treatments (Table 2). This can be attributed to the mild finishing season.

Table 2: Grain and biomass yield and components from the 2010 growing season for each summer rainfall treatment.

Summer Rainfall	Biomass yield (t/ha)	Grain yield (t/ha)	Grain weight (mg)	Harvest Index (%)
1 Event	13.3	5.54	42.1	42
2 Events	12.6	5.35	42.6	42
3 Events	12.2	5.19	42.3	42
Nil	11.7	5.04	42.1	43
P Value	n.s	n.s	n.s	n.s

Trial 2 – The interaction of stored water and nitrogen on grain yield

Across the three trial sites the results were variable. At Roseworthy grain yield averaged 6.0 t/ha regardless of any stored moisture or extra nitrogen.

The Spalding site responded significantly to the addition of nitrogen, averaging 5.0 t/ha in the low nitrogen treatment and 7.1 t/ha in the high nitrogen treatment (100 kg N/ha). However, the 100mm of irrigation applied in late March made no difference to grain yield.

Hart was the only trial site where there was a significant grain yield response to both irrigation and nitrogen treatment. That is the combination of 100mm water irrigated on the 12th February and 70 kg N/ha of nitrogen produced 7.17 t/ha. This is significantly greater than the other treatments by nearly 1.5 t/ha, and was due to a higher number of heads.

The interpretation of these results requires further analysis, as they could be dependent on sowing time, soil nitrogen levels, growing season rainfall and so on.

Table 3: Grain and biomass yield and yield components for Hart, Spalding and Roseworthy in 2010.

Summer Rainfall	Nitrogen	Grain yield (t/ha)	Biomass yield (t/ha)	Grain weight (mg)	Heads/m2	Harvest Index (%)
Hart						
Control	High	5.64	13.3	39.3	346	42
Control	Low	5.78	13.8	42.7	351	42
100mm	High	7.17	17.1	40.2	424	42
100mm	Low	5.68	13.7	42.5	313	42
	P Value. S.R	0.01	0.01	n.s	n.s	n.s
	P Value. N	0.01	0.01	0.01	0.01	n.s
	P Value. Interaction	0.01	0.01	n.s	0.01	n.s
Spalding						
Control	High	7.21	18.5	43.2	539	39
Control	Low	4.96	13.1	45.8	374	38
100mm	High	6.95	17.6	45.5	484	39
100mm	Low	5.01	13.3	47.0	351	38
	P Value. S.R	n.s	n.s	0.05	n.s	n.s
	P Value. N	0.01	0.01	0.05	0.01	0.01
	P Value. Interaction	n.s	n.s	n.s	n.s	n.s
Roseworthy						
Control	High	5.63	15.0	32.9	397	38
Control	Low	6.04	15.5	39.0	413	39
100mm	High	6.00	15.6	35.0	374	38
100mm	Low	6.27	15.2	45.2	337	41
	P Value. S.R	n.s	n.s	0.05	n.s	n.s
	P Value. N	n.s	n.s	0.001	n.s	n.s
	P Value. Interaction	n.s	n.s	n.s	n.s	n.s